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QUARANTINE METHODS.

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No subject of importance is perhaps less understood than that of quarantine. Therefore, the general public is not familiar with the changes which have taken place in maritime sanitation during the past few years. Travellers who come within its jurisdiction are restless until released and are often too ready to condemn a service which occasionally is the cause of a disagreeable detention. To the residents of inland towns, quarantine methods are practically unknown; and only a transient interest is taken in the subject in seaports, where the quarantine restrictions imposed are apt to be looked upon solely as an obstruction to commerce. That unscientific and unpractical work has at times brought quarantine into deserved ridicule is only too true; fortunately, however, a new era in this work has been established and the treatment of infected ships (which in the past has been largely guided by theory) will hereafter, at a properly equipped quarantine station, be directed in a manner consistent with the positive knowledge of established facts which we now possess as the result of scientific research.

In order to appreciate fully the changes which have taken place, it is necessary to compare the methods of earlier times with those which are now employed. To a modern sanitarian, a review of quarantine from the fourteenth to the beginning of the present century is anything but satisfactory. The impotent and empirical methods then employed were almost on a plane with the incantations of the Indian medicine man. After 1800, Jenner's discovery of the protective power of vaccination caused considerable improvement in quarantine methods. From that time on more or less advancement was made, and the subject gradually

attracted the earnest attention of the scientific men of the world. Progress in this direction has been necessarily slow, as the work has been based largely on theory. Within the past ten or fifteen years, however, bacteriological investigations have given us indisputable evidence regarding the life and character of the germs which produce the infectious diseases (pathogenic organisms). The knowledge thus acquired has made it possible to study the action upon these micro-organisms of agents known as disinfectants and to ascertain the germicidal power of the latter. Positive knowledge as to the value of a disinfectant enables us to follow a course determined by facts and not by theories. Although the investigations in this direction are not complete, they have progressed sufficiently far to insure the most promising results.

“Quarantine,” which from its derivation means a detention of 40 days, was originally instituted as a means of protection against the Bubonic Plague, an outbreak of which during the past year has so seriously affected Bombay. It is probable that the first attempt to establish a quarantine station was made in Venice, in 1348. It was at that period that the Plague, under the name of the “Black death,” prevailed in Europe. The devastation which ensued seems almost incredible. Hecker estimates that 25,000,000, or one-quarter of the population of Europe, succumbed to this disease; 50,000 died in Paris, and out of a population of 2,000,000 in Norway, only 300,000 survived. It is not to be wondered at that the most drastic measures were taken to shorten this reign of terror. There is very little to show, however, that the means employed were effective, either at the seacoast or in the interior. Still, occasionally, we find evidence of good work; for example, during the outbreak of the Plague, which occurred in Italy in 1656, there were 300,000 deaths from this disease in Naples, and only 1,400 in Rome. This was attributed, and probably justly so, to the strict sanitary precautions enforced by Cardinal Gastaldi in the latter city.

The quarantine regulations first begun in Venice were subsequently put in operation along the Mediterranean coast, and in 1710 and 1721, by acts of Parliament, a rigorous quarantine was established in England against the introduction of the Plague. This was afterwards made operative against other “highly infectious disorders.” That no well-defined idea of the methods necessary to insure protection against infectious disease existed at

this period is shown by unwarranted measures enforced in the treatment of presumably infected ships. For instance, in 1721, two vessels arriving in England laden with cotton from Cyprus, then affected with the Plague, were burned with their cargoes, the owner receiving an indemnity of \$116,324; and as late as 1800 two vessels bringing hides from Morocco were ordered sunk by the British authorities, for which the government paid \$72,900. The quarantine fees exacted from ship owners frequently amounted to from five to twenty per cent. of the value of the cargo. These charges were frequently imposed on ships carrying clean bills of health. The treatment of the cargo usually consisted of exposing the goods on the deck of the vessel from ten to twenty days; at the expiration of that time they were removed to a lazaret for an additional period of forty days. Vessels were, therefore, frequently detained in quarantine for two months or more. The quarantine service of this date was not improperly called a "commerce destroyer." Lazarets for the reception of persons and goods were constructed at great expense to the state, and were frequently managed in a lavish and ineffective manner.

It does not require a very careful study of the epidemics which in the past so seriously affected Europe to appreciate that the long and unnecessary quarantines imposed did not have the desired effect, and frequently after the liberation from quarantine of a ship's passengers, crew, and cargo, secondary cases occurred on land, which were traced to infection carried from the ship. With this loss of faith in prolonged detention in quarantine came a determined effort on the part of the public, or at least the commercial element of it, to secure a relief from the onerous restrictions imposed upon commerce. As a result, in England particularly, the period of quarantine was gradually reduced, until at the present time there is practically no detention imposed in that country. In the Eastern countries, for instance in Greece and Turkey, we still find restrictions which are as unnecessary and inconsistent as those which existed 200 years ago. The absurdity of this is still more evident when we appreciate the utter disregard the people of the East have for sanitary regulations. As a result these peoples are always in a condition to favor the propagation of infectious diseases and they constitute thereby a menace to the world. The danger from these visitations depends largely upon the sanitary condition of the community where the outbreak

occurs ; no fact is better known or appreciated by those having in charge the public health. Filth, squalor, and famine extend a very cordial reception to the germs of the infectious diseases ; while cleanliness and good sanitary regulations act as serious, and almost insurmountable, barriers to their entrance and propagation. At Eastern seaports, however, where Europeans constitute a large portion of the population and have more or less official influence, the quarantine service is relatively better. I was very much impressed with this during a recent inspection of the sanitary system of Egypt, which is practically in charge of Englishmen. The modern methods here employed and the great improvements which have recently been made in the disinfecting apparatus, and in the construction of laboratories, all show that even in this remote place it is appreciated that a new era in quarantine methods is at hand.

The constant tide of immigration to this country, bringing as it does an extremely undesirable class, has made it necessary to prepare for the reception of these persons in such a manner that they cannot act as a menace to the public health. That this is a very difficult task is evident to any one who will carefully investigate the details of the work. As a natural sequence of the stimulus thus afforded, the different quarantine stations in the United States are better equipped than in any other part of the world. It is here, also, that the needs of the service are better appreciated and the obstruction to commerce less ; and although there is some want of harmony in the details of the work, it is rapidly becoming uniform under the influence of the accumulating facts resulting from scientific research.

It may very properly be asked in what essential points will the quarantine methods of the future differ from those of the past, and the answer is in the substitution of thorough and scientific disinfection in place of long and unnecessary detention in quarantine, particularly as it relates to the ship itself. I will explain this as follows : A vessel may arrive at a port with a case of infectious disease on board ; it is frequently the case that the ship, crew, and passengers are detained for a period representing the incubation of the disease in question. Let us for a moment analyze this action. If the ship is thoroughly disinfected, how can it be a menace to the public health and why should it not be released immediately upon the comple-

tion of the disinfection? On the other hand, it is manifestly improper that it should be detained merely to hold the crew and passengers under observation. *First.* Because it violates one of the cardinal principles of marine sanitation, inasmuch as it practically brings together in one body persons who at any moment may develop an infectious disease, whereas persons under observation should be as far as possible divided into small groups. *Second.* Because the outbreak of secondary cases among the passengers or crew held for observation on board would frequently involve the necessity of again disinfecting the ship. It will be easily understood that this may continue indefinitely until the ship is practically a pest-house. This unnecessarily subjects the ship-owner to a loss of his cargo, if it is perishable, and also the loss of the ship's service. A detention of a vessel for this purpose can hardly be justified on the grounds that a quarantine has no accommodation for the care of persons under observation. Fortunately it is exceedingly rare that the vessel's cargo acts as a medium of contagion; cases of infectious disease develop after the vessel has put to sea and there is no communication between the patient and cargo, the latter being covered with sealed hatches. It has also been proven that the ordinary cargo does not offer favorable conditions for the propagation of pathogenic organisms; this is particularly so with sugar. It is fortunate that this is the case, as the proper disinfection of a ship's cargo and hold is almost an interminable task. It is, therefore, evident that the first action taken upon arrival of a ship carrying infectious disease is the removal of the sick to the hospital; and, if necessary, of both the passengers and crew to a place where they can be held for disinfection and observation. The ship should then be thoroughly disinfected and allowed to proceed, as further detention can add nothing to the protection already assured. In this manner we have properly fulfilled our obligations to commerce and the public.

It is generally accepted, I believe, by those who are competent to decide this matter, that steam is the most important disinfectant which we possess, its chief value being due to the uniformity and rapidity of its action and its great power of penetration. At present its application is confined principally to the disinfection of clothing, bedding, and similar textile materials.

For years the value of steam has been appreciated, but further observations were needed to show the degree of temperature and exposure necessary to destroy the organisms of different infectious diseases under given conditions. During the past ten years, valuable information in this direction has been secured as the result of bacteriological investigations. The experiments, however, have mainly shown the effect of steam on the exposed bacilli in the laboratory. Although these experiments are absolutely necessary in forming a standard upon which to work, they do not indicate the degree of temperature needed in treating the materials which are presented at quarantine and other public stations for disinfection. Here it is presumed that the germs are hidden in bundles of clothing, bedding, and packages of different material. Moist heat at a temperature of 150°, Fahr., which experiments have shown will kill the germs of many infectious diseases directly exposed to it, cannot be depended upon to destroy micro-organisms confined in bundles, etc. It is therefore essential that we should know the penetrating power of steam or moist heat. Comparatively low moist temperatures have very little penetrating power. This is shown by placing a self-registering thermometer inside a package which is subjected to a temperature of 150 degrees, Fahr. The thermometer will probably register about 100 degrees, Fahr.—a temperature which is not only not germicidal, but is most favorable to the multiplication of micro-organisms, whereas a moist temperature of but 130 degrees or 135 degrees is often destructive to germ life. It is also essential that we should know the resistance to penetration shown by the different articles submitted to treatment. In order to obtain this information a series of experiments have been made during the past year at the New York quarantine station, the results of which have been very satisfactory. The tests have conclusively shown the degree of temperature and exposure necessary under definite conditions to insure thorough disinfection. These results also aid in removing the uncertainty with which steam disinfection has often been applied, both as to the degree of heat required and the length of exposure necessary. As the result of the experiments above referred to, a number of important modifications of the steam apparatus employed have been made. It is now possible to practically dry the clothing, etc., before removal from the steam chamber, so that

it can be worn immediately upon the termination of disinfection, instead of waiting an indefinite period for drying.

The experiments referred to were made with the apparatus now in use on the disinfecting steamer "*James W. Wadsworth*," which constitutes a thoroughly representative type of the perfected steam disinfecting chamber of the present day. The tests were made by soaking small linen discs in bouillon containing the germs of the Bubonic Plague, diphtheria, and anthrax. The spores of the bacilli of anthrax are particularly hard to kill, and are looked upon as a severe test in any experiment. The germs referred to were made particularly virulent by the inoculation of white mice and guinea pigs, this portion of the work being done at the Bacteriological Laboratory of the Health Officer's Department at Swinburne Island. The infected linen discs were placed inside of bundles of clothing, bedding, carpets, paper, etc., these packages being arranged in a shape similar to those usually presented for disinfection. It was found early in the experimental work that paper offered a decided resistance to the penetration of steam—much more than any other material. It was therefore constantly used in the tests. The infected discs were inclosed in packages of paper of different weight and tightly folded; in fact, the amount of paper used exceeded the weight of any wrapping that might be used for packages in transit. Canvas bags containing clothing in the manner used by sailors, heavy mattresses, carpets, and rugs, blankets, sheets, etc., etc., tightly rolled, containing infected discs inclosed, were also tested, the weight of each package being carefully taken in order that the results could be corroborated by second and third tests of exactly the same character, this being done to guard against errors. At the expiration of the test, the discs were at once removed and placed in glass tubes containing bouillon to revive and facilitate the growth of the germs if they were still alive. The discs remained in this condition for a week, or until it could be definitely settled as to the growth of the micro-organisms. Although the results, which are voluminous, cannot be given in detail in this article, it may be said that a summing up of the work showed positively and conclusively that steam at a temperature of 230 degrees, Fahr., with an exposure of 15 minutes will destroy all germs which may be exposed or contained in bundles of clothing, bedding, etc., presented for disin-

fection. Self-registering thermometers were in some cases placed inside the packages with the infected discs in order to ascertain the degree of temperature which reached the interior of the package, and it was of great interest and value to know that in all cases a temperature of 150 degrees, Fahr., at least was reached in the largest and heaviest packages of newspapers; whereas in the ordinary package of clothing, bedding, etc., it varied from 175 to 230 degrees, Fahr.; the latter being the temperature of the steam chamber.

These results fully corroborate the laboratory experiments, which have shown that a moist temperature of 150 degrees, Fahr., will usually kill the germs of most infectious disease when directly in contact with them.

It must be understood that the range for practical disinfection with steam is somewhat limited. Materials containing leather, rubber, wood, etc., are permanently injured or destroyed by steam. However, the materials which most frequently carry contagion, such as clothing and bedding, are promptly and effectively acted upon without injury. It is particularly unfortunate that a disinfectant so powerful and reliable as steam should be limited in its practical application, and the urgent need of a reliable agent, which can be used where steam is impracticable, has been fully appreciated. There has been no need of a stimulus to discover a disinfectant which will answer this requirement. It would seem that our hopes in this direction are about to be realized, or, I may say, to a great extent have already been realized.

In 1868, Professor Hoffman, a German investigator, discovered the disinfecting properties of formaldehyde gas, generated by the oxidation of wood or methyl alcohol. But not until the past three or four years, during which time the experimental work with disinfectants has been most active, has this agent received a thorough investigation. The past year has been prolific in valuable experimental investigations with this gas conducted in the best laboratories of this country and abroad.

In conjunction with the experiments made with steam already described, important tests have been made with formaldehyde gas at the New York Quarantine station. Packages similar to those used in the steam experiments have been exposed under various conditions to this gas. These have been made in con-

junction with work done in the laboratory, and although the experimental work is not yet completed, the results are very satisfactory and fully justify us in the conclusion that formaldehyde gas is an agent of pronounced germicidal powers. It also has the rare quality of not injuring the fabrics with which it comes in contact, not in any way affecting the delicate colors found in silks, wall paper, etc. Its penetrating power, however, is not great, but sufficiently so to surely disinfect clothing and bedding, which is unrolled with the surfaces exposed.

Experiments which are now being made with sulphur dioxide or sulphurous acid gas and other disinfectants may yet disclose valuable qualities which are now unknown to us.

During the past year the disinfecting steamer "James W. Wadsworth" has been completed and placed in commission at the New York Quarantine Station; with this it has been possible to make use, in a practical way, of the knowledge gained by the experimental work with disinfectants. The "Wadsworth" is really a portable disinfecting outfit, having the apparatus for disinfection by all the methods now approved. The vessel is always under steam both night and day, and is ready for use at an hour's notice; with it disinfection can be performed at any point in the harbor or connecting waters at any time. The importance of this can only be fully appreciated by those who are directly interested. Before the completion of this outfit it was necessary to remove to the disinfecting station on Hoffman Island in the lower harbor all goods which required disinfection. The time required for transportation involved considerable delay to the ship, particularly in disagreeable or foggy weather. Night disinfection was practically out of the question. Now the weekly mail from Bombay, India, is frequently treated during the night and delivered to the post-office in New York ready for the morning delivery.

Vessels which are usually held for disinfection at the New York Quarantine carry merchandise and no passengers. They come from ports which are known to be infected—generally with yellow fever. These vessels often remain in the infected port some time, and the crew are allowed to visit the shore. Their places of rendezvous on land are generally those in which contagious disease thrives. While the crew may not themselves become infected, it is possible for them to act as a medium of contagion,

or rather carry on board infected clothing, etc. Therefore, as a matter of precaution, at certain times of the year, these vessels are subjected to a thorough disinfection at this port, even if all on board are well. Thus no element of doubt remains as to the possible presence of contagion on board, and the vessel proceeds to the city in a clean and wholesome condition. The frequency with which disinfection is now performed renders it imperative that every effort should be made to interfere as little as possible with commerce. The construction of the "James W. Wadsworth" has, I believe, reduced this period of detention to a minimum. A general description of its use may be of interest. Upon the arrival of a vessel which is required to be held for disinfection, the "Wadsworth" steams alongside and is fastened to the ship. The crew, under the supervision of a quarantine officer, place their clothing and bedding in bundles, which are transferred to the disinfecting boat. Through an opening in the after part of the deck they are dropped into the cradle of the disinfecting chamber, which has been pulled out for their reception. In this cradle are also placed the ship's hangings and all other materials which are to be disinfected by steam. The crew are then transferred to the deck of the "Wadsworth" and pass down the companionway in the stern and enter the disrobing-room. Here they remove their clothing, which is also put in bundles, and upon which are pinned metallic checks containing numbers. Duplicates of these numbers on rubber cords, are hung around the necks of the owners. These bundles are placed with the others in the steam chamber. The men pass forward to the bathrooms, and after bathing they again pass forward into the dressing-room, where, upon the presentation of their checks, they receive their clothing and their effects which have passed through the steam apparatus. After dressing they ascend to the deck of the "Wadsworth" and return to their ship; the bedding, etc., is also returned immediately after treatment. Materials such as furs, silk goods, leather, etc., which are injured by steam are placed in separate packages and dropped through an opening in the forward part of the deck into the steel chamber constructed for disinfection with formaldehyde gas. After the removal of the crew, clothing, bedding, etc., from the ship, employees of the "Wadsworth" are sent aboard for the purpose of scrubbing, cleaning, and disinfecting the fore-castle

and other apartments marked for treatment. A hot soda solution is first used. This is carried from tanks on the disinfecting boat by hose. The application of this solution with the aid of brushes removes the grease and filth; following this cleaning, the woodwork is sprayed with a solution of corrosive sublimate, or the apartments are fumigated with sulphurous acid gas. Upon the completion of the treatment described, and the return of the men to the ship, the disinfection is completed and the vessel allowed to proceed. Particular attention is always paid on these ships to the fore-castle, which is usually filthy and almost always the seat of infection, when it exists on board. It is a source of considerable satisfaction to witness the demonstration of pleasure, upon the part of the crew, upon entering the apartments assigned to them on the "Wadsworth." These rooms are supplied with a metallic lining, enamelled white, which covers the walls, ceiling, and floors, and which is kept scrupulously clean; with the pleasing interior, plenty of clean towels, a shower bath having an agreeable temperature, they evidently feel that there is nothing more in this line to be desired. The ships in question carry a crew of from ten to forty or fifty, and the entire treatment occupies about five hours. This, however, does not include the disinfection of the cargo or hold of the vessel, which only in rare instances is presumably infected. Should a case of contagious disease be found on board, the individual is first removed and the treatment above described follows, after which the crew is either removed to Hoffman Island for observation, leaving the agent to select other men to take the vessel to the city, or the ship remains at quarantine with the crew on board. This is admissible, as the number is small and can be consistently cared for on board. The general rules, as above described, are modified in certain instances, but the principle of the work is adhered to in all cases.

On the arrival of a large passenger ship having on board one or more cases of infectious disease, the cases are first transferred to the hospital at Swinburne Island, the passengers and their luggage removed to Hoffman Island for disinfection alone, or disinfection and observation—depending on the disease and the amount of exposure. The ship and crew are then treated in the manner already described.

Simply an outline of the procedure has been given. A description of the details of the work and the great care neces-

sary during the inspection and disinfection would exceed the limits of this article.

In conclusion, I may say that with the exercise of proper care and the use of the modern appliances already described, it is reasonable to assume that the detention of a ship beyond the period necessary for thorough disinfection will soon be a thing of the past. Quarantine detention will then affect only passengers and crew, who are held for observation, or to complete a period of incubation. I repeat what I have already said, that the treatment of a presumably infected ship and passengers together is as a rule impracticable, inconsistent, and not sustained by experience, and that an infected ship and its passengers should, if possible, part company immediately upon the arrival in port, that each may be treated as the occasion demands. The fact that a port of entry does not contain accommodations for persons held for observation is unfortunate for all.

It would seem that with the practical application of the scientific knowledge of germ life we now possess, and with the absolute certainty of the destruction of these micro-organisms by proper disinfection, the quarantine work of the future will receive the respect and hearty co-operation of the public.

ALVAH H. DOTY.